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(12) # EUROPEAN PATENT APPLICATION

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(54) **Improvement in or relating to fire grates.**

(57) A solid-fuel fire grate is made-up of hollow steel tubes (13) which extend between side sections (3, 5) of a domestic wrap-around boiler. The tubes (13) are curved and one end (13a) is lower than the opposite end (13b). This provides a water flow through the tubes (13) when the grate is in use, providing water heating and circulation in the boiler. Cold water is supplied through inlets 7, and hot water is provided through outlets 9. A flue has an inlet 6 and an upper outlet 8.

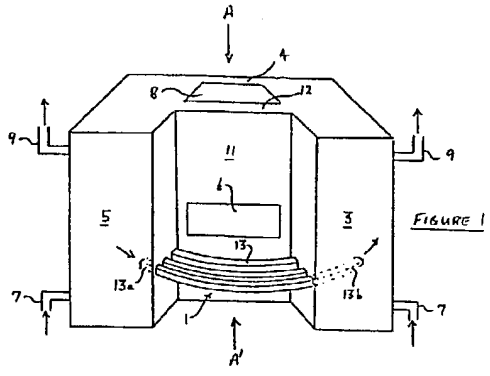

FIGURE 1

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"IMPROVEMENTS IN OR RELATING TO FIRE GRATES"

This invention relates to fire grates and particularly, but not exclusively, to such a grate when in combination with a boiler.

Conventional fire grates for solid fuels such as coal comprise simply a grating for supporting the coal, the grating enabling the coal to burn freely with good access of air, and enabling ash to drop between the grating into an ash bin. Such grates are usually incorporated in fire arrangements such as to be surrounded on all but one side by fire bricks or similar ceramic materials in order to project heat forward into the room in which the grate is located. Fumes from solid fuel burning in the grate are carried upwards through a flue and out into the atmosphere via a chimney. Many such domestic solid fuel grates have been adapted to heat water for domestic use, either simply to provide a hot water supply for washing purposes, or to supply hot water for circulation about the house via pipes and radiators so as to constitute a solid fuel central heating system which has an open fire as its heat source, or alternatively a closed solid fuel burning appliance.

In such adapted systems as mentioned above, the grate is conventionally located adjacent a water container,

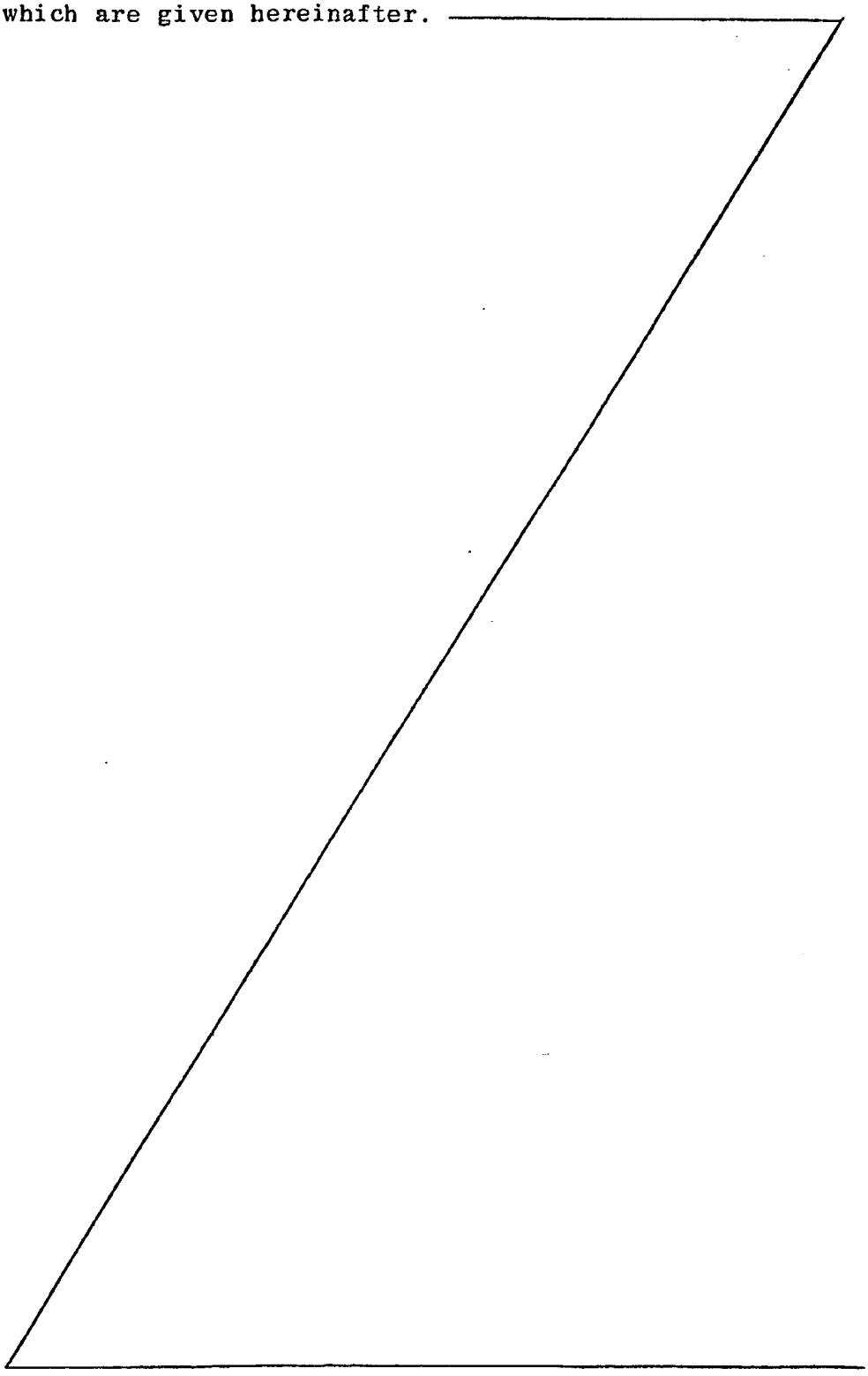
and heat exchange between the fire and water in the container takes place over a large generally flat surface. Thus the hot water tank of such a system may be located at the back or sides of a fire grate, and be provided with a cold water inlet and hot water outlet to the radiators and hot water storage point. To secure a good heat exchange in such a system, that is to provide efficient heating of the water, there must be a large surface area which is common to the fire and to the tank. Thus the fires generally used in such a system have to be extremely hot and also large. Thus there is in this case a frequent need for replacement of the grate elements, and maintenance of the system. Moreover, since it is necessary for a large fire to be generated before water heating commences, there is not usually a rapid response between the lighting of a fire in the grate and the plentiful supply of hot water.

Accordingly, there is a need to provide a system whereby a solid fuel grate, either open or closed, may be designed to yield a rapid and efficient heating of water for domestic and possibly non-domestic purposes; where the fires required are not necessarily extremely hot; and where a relatively small fire volume will give good and efficient water heating.

According to the present invention there is provided a fire grate comprising hollow tubes for carrying water, the tubes together constituting a grate arrangement for retaining solid fuel such that in use, combustion of said solid fuel causes ready heating of water in the tubes by virtue of the proximity of the tubes to the source of heat.

When used for example domestically, a grate according to the invention may be combined for example with a wrap round boiler. Thus in use water passing through the tubes of the grate is heated and then carried into the boiler where a large volume of heated water may be stored for later use, or for pumping around a central heating radiator system. Water flow through the tubes may be

provided by a pump for this purpose, or by the specific shape and/or arrangement of the tubes, some examples of which are given hereinafter.



In a preferred embodiment the grate comprises a curved base which is formed from the hollow tubes, these tubes preferably being of substantially square section, for example 20 mm square, and formed from steel. Optionally the grate may have further tubes or other structural elements which form a front to the grate, but as is common with conventional grates, there may be no front bar. Preferably, though, the grate is shaped to suit the fitting of an all night burner so as to present a cosmetic appearance. An all night burner may comprise a shield with louvred air spaces to give controlled burning of solid fuel in the grate, and to prevent the solid fuel carried on the grate tubes from falling into the room in which the grate is located. Conventional means may be provided for adjusting the air spaces and hence controlling the burning characteristics of the grate.

As is usual, above the grate there may be disposed a flue to take away the fumes from the burning material. It is a feature of the invention that water in the tubes comprising the grate is heated at the best possible place, namely at the point of the fire.

The grate is preferably used in conjunction with a boiler, which may be in the form of a wrap round boiler, with the grate itself essentially disposed centrally of the boiler sections. Typically, such a grate may comprise a solid fuel carrying base of hollow tubes which presents to the user a fireplace of dimension 14". Hence little fuel is required to stock the fire, whilst at the same time efficient water heating is provided. The volume of the boiler depends of course on the use to which the boiler is put. Thus if the water is intended for use in a central heating system, then the volume of the boiler depends on the number and size of the radiators which make up the system. Typically, one section or side of the wrap round boiler may contain an inlet and outlet

to serve as a storage section for a gravity fed cylinder tank. The other section may serve as the hot water source for a central heating system.

As mentioned above the grate need not be constituted entirely of hollow tubes, that is other structural elements may also be included to provide particular features of strength and appearance. Essentially, though, the grate includes hollow tubes through which water may pass and which together constitute a bed for carrying the solid fuel. A typical grate and wrap round boiler arrangement may be some 18" high by 34" wide, with a side section of the boiler disposed on each side of a 14" grate. The balance of the width dimension, in a preferred embodiment, is taken up by insulating material which may be integral with the boiler or placed around the boiler and secured in position e.g. with sand and cement. As insulation there may be used, for example, rocksill retained in asbestos cloth.

The grate itself may be some 6" above the bottom of the arrangement so as to allow a means for collecting ash from the burnt solid fuel to be included under the grate. The depth of the grate may be for example 10", and the grate may incorporate some six or more hollow tubes, preferably eight hollow tubes of 20 mm square section to permit direct water heating at the seat of the fire. Many other dimensions are of course possible, and indeed are preferred for certain uses.

A boiler used in conjunction with a grate according to the invention is of course provided with a cold water inlet at the bottom and a hot water outlet at the top. Preferably each side section of a wrap round boiler has an inlet and an outlet. One side may deliver hot water to a domestic cylinder and the other side for example to central heating radiators. The hot water circulation in such a central heating system may be natural, i.e. a gravity system, or the system may include an electric pump.

It is a particularly preferred development of the invention that the hollow tubes comprising the grate are curved, sweeping upwardly away from what is in use the seat of the fire. This permits the water heated in the tubes by the fire to rise naturally (by virtue of the density difference between hot and cold water) into the side sections of the boiler. It is a preferred development that the curved tubes extend into the side sections with the extension and height being more pronounced into one side than into the other. This facilitates the natural flow of water through the pipes with relatively cold water entering from one side section to replace heated water which is continuously delivered to the other side section. The side sections of such a wrap round boiler are of course connected via a rear section which passes across the back of the grate.

It will be appreciated that the scope of this invention extends not only to the grate itself but also to the grate in combination with the boiler system, and to central heating systems incorporating such a grate and boiler arrangement.

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings in which:

Figure 1 is a schematic front perspective elevation of a grate according to the invention in combination with a wrap round boiler; and

Figure 2 is a schematic cross section through the line A-A' of Figure 1.

Referring to Figure 1 the grate itself is generally designated 1, and is seen to be arranged in conjunction with a wrap round boiler comprising a pair of side sections 3 and 5 communicating through a rear section 4, and a further section 12 all

for containing water. Each side section is provided with a cold water inlet pipe 7 and a hot water outlet pipe 9. Disposed between the side sections 3, 5 and in front of the rear section 4 and arranged above the grate 1 is a flue-defining boiler section 12 with a front face 11, the flue being integral with the boiler for collecting and removing fumes generated by solid fuel which is burnt in the grate. The flue has an inlet 6 and an upper outlet 8.

The grate 1 comprises a plurality of square section hollow tubes 13, only three of which are shown, for clarity. The square section hollow tubes 13 are curved, each having a first end 13a projecting into the side section 5, and a second end 13b projecting into the side section 3; the ends 13b project further and higher than the ends 13a, and so in use of the grate a flow of water in the boiler is promoted. The hot water formed in the boiler naturally reaches the upper levels and is delivered into a central heating system via one of the pipes 9. The other pipe 9 delivers hot water into a domestic cylinder. In some embodiments the ends 13a may be removed so that the tubes 13 terminate flush with the boiler wall at this particular end.

Referring to Figure 2, a cross section of the arrangement of Figure 1 is shown, not to scale. From this it may be seen that the grate 1 in fact comprises eight square section hollow tubes 13 arranged to constitute a base upon which in use the solid fuel is burnt. The heat generated by the burning solid fuel heats water carried in the tubes and, as explained previously, this water then passes into the boiler. The boiler includes a structural strengthening member or stay 10 to give it rigidity during construction of the fireplace.

In the embodiment shown in Figures 1 and 2, the thickness of the tube walls and of the boiler walls may be a constant 6 mm. This thickness provides the required mechanical strength for these components, but it will be appreciated that if this thickness could be reduced at least in parts, this would improve heat transfer from the fire into the water. One way of achieving such a reduction in thickness in a generally 6 mm thick boiler, is to provide thinner, for example 3 mm thick, cheek plates to provide a substantial part of the side boiler walls which are adjacent to the fire and into which run the end regions of the tubes 13. The main part of the boiler could be a permanent fixture in a chimney breast, while the tubes 13 together with the cheek plates could form a separate replaceable unit. Each cheek plate would be bolted to an underlapping inner periphery of the corresponding side boiler wall with a graphite washer and paste being provided between the outer periphery of the cheek plate and the underlapping inner periphery of the corresponding side boiler wall so that the join between the two is watertight. The thinner cheek plates will have portions directly adjacent to the fire and heat transfer here will be greatly improved. If necessary the cheek plates could be reinforced with reinforcing ribs.

In addition, a thin heat transfer plate could be provided in a similar manner in the boiler wall 11, just above the flue inlet 6.

It is to be appreciated that in alternative embodiments of the invention water flow in the hollow grate tubes can be provided in tubes which are shaped and/or arranged differently from those which have been so-far described and/or illustrated. Thus, for example, it may be possible to provide straight grate tubes each of which is lower at one end than at

the other end. When the water in the tubes is heated it will provide a flow from the lower end to the higher end. Alternatively, grate tubes may be provided which are straight and horizontal and which have a larger internal cross-section at one end than at the other end. Water, when heated in such a tube, will tend to expand and flow towards the tube end with the larger internal cross-section.

All the described and illustrated embodiments of the invention have the advantage that a flow of water is provided through the fire grate members themselves. The seat of the fire is by far its hottest part, and so the best heating effect takes place on water in the tubes 13 as opposed to the heating effect on the water in the wrap-around boiler. If the tubes 13 were horizontal tubes with constant internal cross section and with no additional means of providing water flow through them, the heated water in the tubes could not flow effectively through the tubes. The extreme heat at the seat of the fire would produce hot spots in the material of the tubes, and the tubes would soon burn away. A continual flow of water through the tubes avoids hot spots developing and thus prolongs grate life. When the time does come to replace a grate according to the present invention, this can easily be done if the grate is coupled into replaceable cheek plates as described previously.

Finally, at the top surface of the boiler section 12, in front of the flue outlet 8, a plate may be welded for supporting a throat closure plinth brick when the boiler plus grate is installed in a brick fire-place. The presence of that throat closure plinth brick improves the draft in the boiler flue therefore giving a better control of air through the fire bed.

Claims:

1. A fire grate comprising tubes for carrying water, the tubes together constituting a grate arrangement for retaining solid fuel such that, in use, combustion of said solid fuel causes ready heating of water in the tubes by virtue of the proximity of the tubes to the source of heat.

2. A fire grate according to claim 1, wherein the tubes are shaped and/or arranged such that, in use, water heated in the tubes will tend to flow through the tubes.

3. A fire grate according to claim 2, wherein one end of the tubes is higher than the other end.

4. A fire grate according to claim 2 or 3, wherein both ends of the tubes are higher than are the tubes at a central region of the grate arrangement.

5. A fire grate according to any preceding claim, which is part of a solid fuel boiler with the ends of the tubes being in communication with the interior of the boiler.

6. A fire grate according to claim 5, wherein the tubes together with plates into which the ends of the tubes extend, provide a replaceable unit in the boiler.

7. A fire grate according to any of the preceding claims, except claim 4, wherein the tubes are straight.

8. A fire grate according to claim 2, or any of claims 3 to 7 when appended to claim 2, wherein the tubes have a larger internal cross-section at one end than at the other end.

9. A fire grate according to claim 5, or any of claims 6 to 8 when appended to claim 5, wherein the boiler comprises a relatively thin heat transfer plate in a wall of the boiler which faces the grate or a region above it.

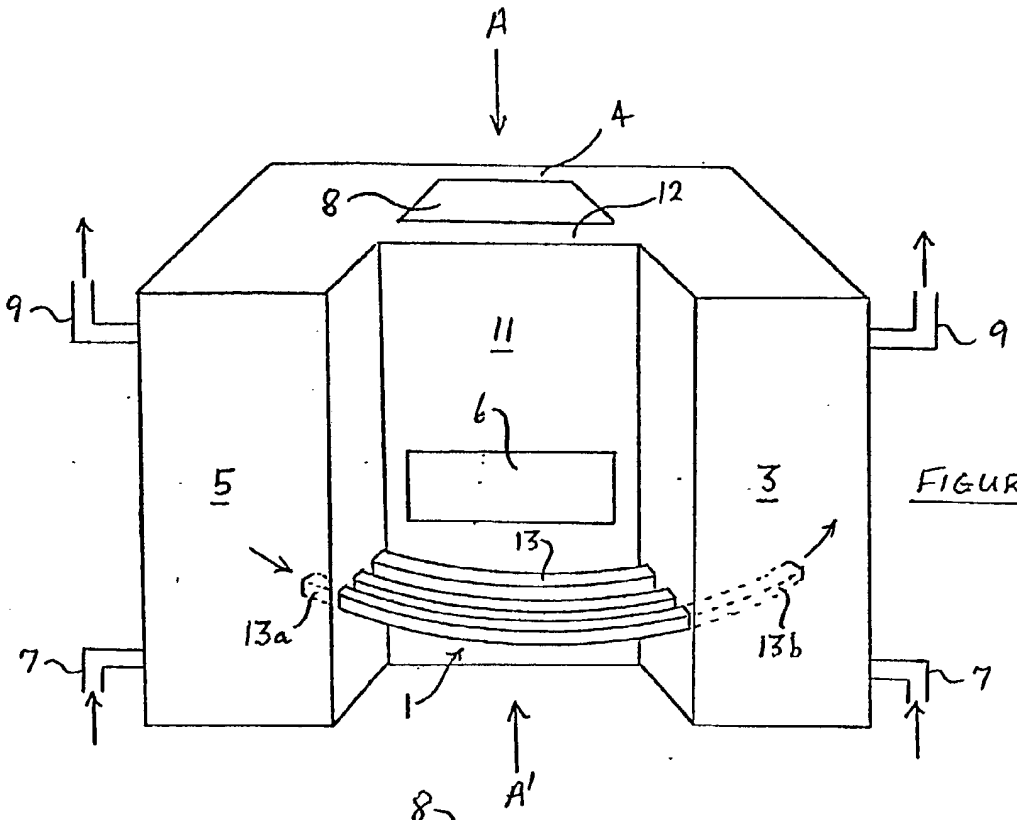


FIGURE 1

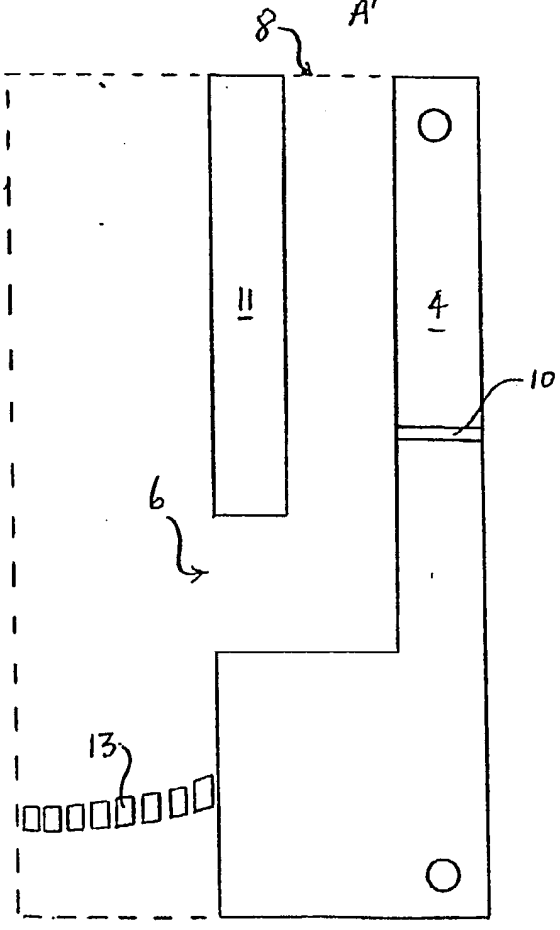


FIGURE 2

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EUROPEAN SEARCH REPORT

Application number

EP 82 30 2568

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
X	GB-A-1 518 585 (SHEEHAN) * Page 1, lines 58-83, 92-96; page 2, lines 1-13, 29-35; figures 1-3 *	1,2,5, 7	F 24 B 9/04 F 23 H 3/02
A	US-A-1 432 538 (DE ARMOND) * Page 1, lines 48-102; figures 1-7 *	1-3,5	
A	DE-C- 165 060 (GRAF) * Whole document *	1-4	
A	FR-A-2 384 209 (MONCHY) * Page 6, lines 14,15,22-35; figures 1,2 *	1,2,5, 6	
A	FR-A-2 463 898 (VALDENAIRE) * page 2, lines 8-23; figures 1,2 *	9	TECHNICAL FIELDS SEARCHED (Int. Cl. ³) F 24 B F 23 H
A	GB-A-1 532 542 (AWALT) * Page 3, lines 49-59; figures 1,2 *	1-3,5	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	03-09-1982	PHOA Y.E.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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& : member of the same patent family, corresponding document

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INVENTOR-INFORMATION:

NAME	COUNTRY
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NAME	COUNTRY
ASPREY GEOFFREY	N/A

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US-CL-CURRENT: 110/299

ABSTRACT:

CHG DATE=19990617 STATUS=O> A solid-fuel fire grate is made-up of hollow steel tubes (13) which extend between side sections (3, 5) of a domestic wrap-around boiler. The tubes (13) are curved and one end (13a) is lower than the opposite end (13b). This provides a water flow through the tubes (13) when the grate is in use, providing water heating and circulation in the boiler.
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